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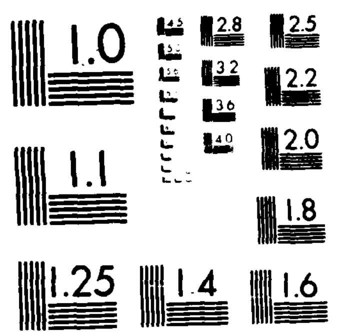

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Details of the activites associated with the processing of GEOSAT satellite radar altimetry data are discussed. Summary statistics and observations obtained during the processing of a limited set of GEOSAT altimeter data are presented. Statistics from comparisons of GEOSAT-derived mean gravity anomalies with those obtained from available survey data are shown. Future plans and directions for the continued processing and exploitations of this data are indicated.

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DARRYL D. TAYLOR
Chief, Data Services
Department

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PRELIMINARY RESULTS OBTAINED BY DMAAC FROM THE PROCESSING OF A LIMITED SET OF GEOSAT SATELLITE RADAR ALTIMETER DATA

BY

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PRELIMINARY RESULTS OBTAINED BY DMAAC FROM
THE PROCESSING OF A LIMITED SET OF
GEOSAT SATELLITE RADAR ALTIMETER DATA

A. GEOSAT DATA PROCESSING SYSTEM

1. General

The satellite radar altimetry group at the Defense Mapping Agency Aerospace Center (DMAAC) has taken an active role in identifying and addressing the tasks associated with the final stages of processing and development of GEOSAT data into gravimetric products. Major products include adjusted along-track geoid heights, gridded geoid heights, and mean gravity anomalies.

The main activities include editing, adjusting for residual radial orbit error, and storage in an on-line database for ready access. Regular shipments of GEOSAT Filtered Geophysical Data (FGD) have been received from the Naval Surface Weapons Center (NSWC) since mid-October 1985. The data is processed in seven-day data sets of approximately 660,000 data records each. To date (November 1986), 17.2 million GEOSAT data records have been processed by DMAAC. This data is stored in 120 15° by 30° "minifiles" of bit-packed, area-sorted data records.

2. Editing

A comprehensive automated program compares the computed geoid heights, deflections of the vertical, and all significant data corrections against predetermined bounds. Rates of change of the gravimetric quantities and corrections are also monitored to guard aginst discontinuities. Flags are set during this procedure which identify the nature and severity of the condition detected. Each revolution of data is profiled and compared against the best available gridded geoid height data and also against available bathymetry. Flag conditions also trigger profile plots of a selected set of up to nine of the data corrections. To aid editing, the along-track geoid height profiles can optionally be projected onto three-dimensional reference surfaces which include known seamount locations. A follow-on interactive edit program affords the analyst the opportunity to view any portion of a revolution in detail, along with the associated data records, and to immediately view the results of an edit action and iterate the activity if necessary.

The GEOSAT data processed thus far has been remarkably clean with minimal editing required. Less than 1.5 percent of the GEOSAT data received from NSWC has been flagged for exclusion from further processing.

3. Adjustment

In what is essentially a geometric computation, the computed geoid heights depend directly on a precise orbit determination. Residual radial orbit errors reveal their presence as differences from one pass to another in computed along-track geoid heights at subsatellite points. These differences are referred to as crossing point differences and directly reflect

the degree of self-consistency of the data. While earth gravitational models and orbit determination procedures have significantly improved (the precise orbits were computed by NSWC using the World Geodetic System 1984 Earth Gravitational Model), some uncertainty remains. The 1.04 meter pre-adjustment crossing point statistic (Table 1) for intersecting passes of ascending and descending GEOSAT along-track data supports the idea that the individual orbits have radial uncertainties less than one meter.

An adjustment procedure using an assumed error model is utilized, which minimizes the computed geoid height differences at points where GEOSAT ground tracks cross each other and where they cross a carefully constructed reference network. This geoid height reference network was constructed from SEASAT data collected during the final three weeks of the satellite's operating life while it was in a repeat track configuration. Geophysicists at the Naval Oceanographic Office (NAVOCEANO) averaged the multiple data along these repeat tracks and adjusted them into a highly self-consistent data set. This network was further modified by DMAAC by filling in sparsely covered areas and increasing the density of the network arcs in known trouble spots. This enhanced network serves as control for the adjustment of the GEOSAT data tracks. The network approach has been exercised successfully by a number of investigators and well documented in several reports, e.g., in [1].

The adjustment model currently used by DMAAC is a three parameter (bias, tilt, and bend) model having constant, linear, and quadratic terms and using the local time along the arc as the independent variable. Arcs are subdivided into ascending and descending parts and further restricted to lengths less than that traversed within 2000 seconds. Data gaps of up to 500 nautical miles are allowed before the segment following the gap is defined as a different arc. The inclusion of the quadratic term in the error model is particularly effective in the alignment of longer arcs, but the linear and quadratic terms make the adjustment process susceptible to the aliasing of oceanographic phenomena into the process. This can become serious for short arcs. In order to monitor this problem, limits are imposed on the magnitudes of the adjustment parameters so that they conform to expected bounds for radial orbit uncertainties and their rates of change. An additional measure of control is obtained by requiring a minimum number of crossings of the unadjusted arcs with themselves and with the geoid height reference network.

The adjustment phase is a critical part of the data processing in that the long wavelength along-track orbit error can manifest itself as a short wavelength random error. This occurs when revolutions adjusted during different times and having different residual error characteristics lie close together in a geographic area. A random selection of points can produce the appearance of fairly large signals of short wavelength. In such a situation, a data rich environment provides the opportunity to average the data and exercise statistical selectivity, thereby reducing the adverse effects of adjustment misalignment (and other random errors as well). Careful editing and adjustment pays dividends since mean gravity anomaly recovery from the geoid height data is in a sense an amplification process and relatively small geoid height errors propagate into sizable errors in the recovered mean gravity anomalies.

Adjustment statistics are summarized in Table 1 for the data processed to date. These results show a 13 centimeter post-adjustment rms for GEOSAT minus GEOSAT groundtrack crossings and an average of 22 centimeters for GEOSAT minus

SEASAT Reference Network groundtrack crossings. The GEOSAT minus GEOSAT statistics increase when the individually adjusted sets are combined and the resulting mixture is tested. Cumulative post-adjustment statistics for the entire 17.2 million point data set involving more than 1.78 million crossing points show a mean of very nearly zero and an rms of 21 centimeters.

The statistics in Table 1 also show the cumulative results of the differences between sampled along-track GEOSAT geoid heights before adjustment and geoid heights computed using a spherical harmonic expansion and the World Geodetic System 1984 Earth Gravitational Model (WGS 84 EGM) through degree and order 180. Assuming the so-called "oceanic" definition of the geoid, whereby the mean sea surface topography over the oceanic areas is taken to be zero, the statistics indicate the compatibility of the spherical harmonic-derived and "observed" GEOSAT geoid heights--at least with respect to overall scale. The agreement to within 10 centimeters is important for applications where gaps in the altimetric geoid heights are filled in or otherwise buffered by spherical harmonic-derived values.

An anomalous situation surfaced during the generation of these comparison statistics. During the analysis, it was noted that the ascending and descending portions of the data arcs did not yield the same statistics. In addition, the results computed on a week-to-week basis changed significantly (Figure 1). However, this situation does not seem to adversely affect data adjustment efforts and the individual data sets appear to be successfully driven to the SEASAT Network.

One aspect of network adjustment deserving comment is the fact that the network imposes its scale and other long wavelength characteristics on the geoid driven to it. This means that any deficiencies in the SEASAT Network will bleed into the GEOSAT geoid adjusted to it. Conversely, gravity anomalies derived from GEOSAT data will benefit from any improvements that can be made to the reference network. This is a critical process and a limiting factor in efforts to improve the recovery of mean gravity anomalies from altimeter data. If a new GEOSAT Network is forthcoming from the GEOSAT Exact Repeat Mission (ERM), it will be profitable to readjust the GEOSAT data using this new network.

B. AN INTERIM GEOSAT GEOID HEIGHT DATA SET

The fully processed GEOSAT geoid heights adjusted to the WGS 84-related SEASAT Reference Network are maintained in the minifile database. The data is readily accessed by utility subroutines which permit the selection of points by attribute and also via statistical comparison with the point data within a selected geographic cell size. The individual points chosen are those which agree best with the average of the points in the cell after the exclusion of those geoid heights that deviate from the average values by more than two sigma. These statistically selected points are referred to as "most representative values" for the cell size specified. Results from the comparison of mean gravity anomalies obtained using geoid heights from various data thinning procedures with "truth" mean gravity anomalies indicate the value of using these "most representative" geoid heights. Since values obtained for the computed mean gravity anomalies are quite sensitive to the geoid heights used in their calculation, statistical procedures designed to reduce random errors will continue to be explored and the results evaluated.

With along-track resolution about the same as SEASAT, and having a low noise level, a 15' by 15' grid was used for the initial production of GEOSAT gridded geoid height data sets. In May 1986, a preliminary gridding was done using approximately 12 million points. "Most representative" values for 5' by 5' cells were used to produce a geoid height value for the center of each 15' by 15' cell using the statistical Weiner-Hopf prediction process. This gridded geoid showed trench, seamount, fracture and ridge areas very clearly and appeared to be free of the adjustment difficulties often experienced with GEOS-3 and SEASAT altimeter data. The 15' by 15' gridded values were then averaged into 1° by 1° mean geoid heights and used to compute 1° by 1° mean gravity anomalies.

For a number of reasons, the random error in the geoid, as implied by post-adjustment crossing point statistics, is not necessarily a reliable indicator of the true level of random error in the gridded geoid. The crossing point differences represent the combined effects of the errors in both the ascending and descending arcs used to compute the differences. One might be tempted to divide by $\sqrt{2}$ to obtain an improved estimate of the level of random error in the along-track geoid height data. Reduced error levels also result from the use of the statistically chosen points and the smoothing associated with the gridding process.

C. MEAN GRAVITY ANOMALY COMPUTATION

1. Formulation

A variety of approaches have been used by various investigators to compute mean gravity anomalies from altimetric geoid heights. The Inverse Stokes Method and least squares collocation [5] have been among the more successful techniques. Although these techniques have been utilized in the past by DMAAC and others, the technique selected for use with the GEOSAT data is a modification of the Molodensky integral:

$$\Delta g_p = -\frac{\gamma N_p}{R} - \frac{\gamma}{2\pi} \int_\sigma \frac{N-N_p}{r_p{}^3}\, d\sigma$$

where

Δg_p = gravity anomaly calculated at the computation point p

γ = mean value of theoretical gravity

N_p = geoid height "observed" at point p

R = mean radius of the earth

r_p = chord distance between the computation point and a differential surface element $d\sigma$, with "observed" geoid height N,

and where the summation extends in principle over the surface of the earth.

This formulation has a distinct advantage over other approaches in that it does not require the inversion of a matrix. It is referred to here as the Direct Integration Method. Early estimates of the recovery capabilities of the Direct Integration Method were on the pessimistic side [1]. Large errors were estimated for workable (tractable) cap sizes of five to six degrees due to the omission of observed geoid height data outside the cap. The strategy used to reduce this error is to analytically represent it in such a way that the functional representation can be incorporated into the gravity anomaly computation and the remainder minimized. Use of truncation coefficients together with an accurate spherical harmonic-derived reference geoid to represent a portion of the missing geoidal information outside the cap area is described by Jekeli [2] and Gaposchkin [3]. The latter reference gives a formulation that is close to that developed by DMAAC. While these modifications have greatly reduced the error of omission, additional stress is placed on the geoid data available for use in the mean gravity anomaly calculation in that the modified kernel becomes more responsive to data errors. For the results discussed herein, a six degree cap was used with the above equation for Δgp, and a spherical harmonic expansion through degree and order 12 provided the reference geoid.

2. Interim Mean Gravity Anomalies Deduced From GEOSAT Data

Full sets of 1° by 1° and 30' by 30' mean gravity anomalies were generated in the ocean areas, to within two to three degrees of land, using means of the 15' by 15' gridded geoid heights described earlier. The generated 1° by 1° mean gravity anomalies were then compared with similar values computed from the best available gravity survey data (Table 2). The mean gravity anomalies compared represent gravimetrically smooth, intermediate, and rough areas. Use of a cosine window weighting in the averaging of the 15' by 15' geoid heights improved the results. However, the direct computation of 30' by 30' mean gravity anomalies and the averaging of those into 1° by 1° values agreed best with the 1° by 1° values obtained from the gravity survey data. For this method, no 5° by 5° area showed a sigma for the differences greater than four milligals. Methods two and three (Table 2) both have the beneficial effect of diminishing the aliasing resulting from the straight averaging of the 15' gridded geoid heights in the 1° by 1° areas to obtain 1° by 1° mean geoid heights. In the future, attention will be given to the generation of 15' by 15' mean geoid heights with benefits expected in gravity anomaly accuracy from use of the smaller size cells.

3. Some Oceanographic and Bathymetric Characteristics Noted from the GEOSAT Data

The North Atlantic area off the east coast of the United States has often been identified as an area of strong dynamic sea surface topography. The Gulf Stream current, eddies, cold rings, and a high level of variability in the mean sea surface, are all associated with this region. The unusually large post-adjustment crossing point differences observed there (37 centimeters rms) is a possible indicator of such dynamic effects.

Bathymetric features are beginning to be resolved in the 30' by 30' mean gravity anomaly field. An image made from the 30' by 30' means in the North Atlantic (Figure 2) shows details of the mid-Atlantic Ridge and several facture zones.

D. CONCLUSIONS/FUTURE DIRECTIONS

Although only approximately one-third of the available GEOSAT data has been processed and utilized to date (November 1986) by DMAAC, the Navy GEOSAT Program can unequivocally be proclaimed a huge success. The management and technical expertise exercised by involved Navy organizations and The Johns Hopkins University/Applied Physics Laboratory (JHU/APL) has produced an oceanic altimetric data set of unparalleled accuracy.

Efforts will be directed toward reducing errors in the geoid heights, taking advantage of the data rich environment provided by the full complement of GEOSAT data. A 7.5' by 7.5' gridded geoid will be produced and 15' by 15' mean gravity anomalies computed and evaluated. Any developments in the modeling of oceanographic effects, particularly the quasi-stationary currents, will be reviewed for possible application. Improvements expected from a network of GEOSAT repeat track data is eagerly awaited.

Mean gravity anomalies obtained from the GEOSAT data compare more favorably with mean gravity anomalies developed from ship gravity data than any previous altimetry-derived results, including those achieved from a combination of GEOS-3 and SEASAT data -- using any computational strategy. It is also evident, however, that much work remains if the full potential of this rich GEOSAT data set is to be realized.

REFERENCES

1. Buglia, J.J.; The Effect of Remote Zones on the Accuracy of Evaluating the Molodensky Integral; National Aeronautics and Space Administration Technical Memorandum (NASA TM); TM X-72796; Goddard Space Flight Center; Greenbelt, Maryland; January 1976.

2. Jekeli, C.; Reducing the Error of Geoid Undulation Computations by Modifying Stokes' Function; Department of Geodetic Science and Surveying Report No. 301; The Ohio State University; Columbus, Ohio; May 1980.

3. Gaposchkin, E.M.; Geodetic Use of GEOSAT-A; Air Force Geophysical Laboratory Technical Report (AFGL TR); AFGL-TR-83-0254; Hanscom Air Force Base, Massachusetts; August 1983.

4. Rowlands, D.: The Adjustment of SEASAT Altimeter Data on a Global Basis For Geoid and Sea Surface Height Determination; Department of Geodetic Science and Surveying Report No. 325; The Ohio State University; Columbus, Ohio; December 1981.

5. Tscherning, C.C. and Rapp, R.H.; A Fortran IV Program for the Determination of the Anomalous Potential Using Stepwise Least Squares Collocation; Department of Geodetic Science and Surveying Report No. 212; The Ohio State University; Columbus, Ohio; July 1974.

TABLE 1

SUMMARY OF GEOSAT GEOID HEIGHT ADJUSTMENT STATISTICS

<table>
<tr><td rowspan="3">TOTAL NUMBER OF PROCESSED GEOSAT POINTS</td><td colspan="6">PRE-ADJUSTMENT STATISTICS</td></tr>
<tr><td colspan="4">WGS 84 GEOSAT GEOID HEIGHTS COMPARED TO WGS 84(n=m=180) GEOID HEIGHTS</td><td colspan="2" rowspan="2">RMS OF GEOSAT/GEOSAT GEOID HEIGHT CROSSING POINT DIFFERENCES (m)</td></tr>
<tr><td colspan="2">NUMBER OF COMPARISONS</td><td colspan="2">MEAN OF DIFFERENCES(m)</td></tr>
<tr><td>17,296,452</td><td colspan="2">1,071,813</td><td colspan="2">-0.10</td><td colspan="2">1.04</td></tr>
<tr><td rowspan="6"></td><td colspan="6">POST-ADJUSTMENT STATISTICS FOR INDIVIDUAL SEVEN-DAY DATA SETS</td></tr>
<tr><td colspan="3">RMS OF GEOSAT/GEOSAT GEOID HEIGHT CROSSING POINT DIFFERENCES(m)</td><td colspan="3">RMS OF GEOSAT/REFERENCE NETWORK GEOID HEIGHT CROSSING POINT DIFFERENCES(m)</td></tr>
<tr><td colspan="3">0.13</td><td colspan="3">0.22</td></tr>
<tr><td colspan="6">POST-ADJUSTMENT STATISTICS FOR ALL POSSIBLE GEOSAT/GEOSAT CROSSING POINT DIFFERENCES FOR DATA PROCESSED</td></tr>
<tr><td>NUMBER OF POINTS</td><td colspan="3">MEAN OF CROSSING POINT DIFFERENCES(m)</td><td colspan="2">RMS OF CROSSING POINT DIFFERENCES(m)</td></tr>
<tr><td>1,783,837</td><td colspan="3">-0.0005</td><td colspan="2">0.206</td></tr>
</table>

TABLE 2

COMPARISON OF GEOSAT DERIVED 1° BY 1° MEAN GRAVITY ANOMALIES* WITH "TRUTH" 1° BY 1° VALUES COMPUTED USING GRAVITY SURVEY DATA

MEAN GRAVITY ANOMALY COMPUTATION METHOD	NUMBER OF VALUES COMPARED	MEAN GRAVITY ANOMALY DIFFERENCES					
		RMS	MEAN	MAXIMUM		NUMBER OF DIFFERENCES	
				POSITIVE DIFF	NEGATIVE DIFF	>10 MGALS	>20 MGALS
1	4534	2.7	0.33	23.4	-28.2	37	3
2	4534	2.3	0.34	14.4	-18.8	16	0
3	4523**	2.1	0.34	11.2	-13.3	6	0

	DESCRIPTION OF GEOSAT GEOID HEIGHT INPUT DATA USED IN MEAN GRAVITY ANOMALY COMPUTATIONS
1	1° BY 1° MEAN GEOID HEIGHTS OBTAINED AS A SIMPLE AVERAGE OF THE 15′ BY 15′ GRIDDED GEOID HEIGHTS AVAILABLE WITHIN EACH 1° BY 1° AREA.
2	1° BY 1° MEAN GEOID HEIGHTS OBTAINED USING A COSINE WINDOW WEIGHTING OF THE 15′ BY 15′ GRIDDED GEOID HEIGHTS AVAILABLE WITHIN EACH 1° BY 1° AREA.
3	30′ BY 30′ MEAN GEOID HEIGHTS OBTAINED AS A SIMPLE AVERAGE OF THE 15′ BY 15′ GRIDDED GEOID HEIGHTS AVAILABLE WITHIN EACH 30′ BY 30′ AREA. THESE 30′ BY 30′ MEAN GEOID HEIGHTS WERE USED TO COMPUTE 30′ BY 30′ MEAN GRAVITY ANOMALIES WHICH WERE THEN AVERAGED TO OBTAIN 1° BY 1° MEAN GRAVITY ANOMALIES.

UNITS FOR 1° BY 1° MEAN GRAVITY ANOMALY DIFFERENCES = MILLIGALS

* *INTERIM VALUES (BASED ON ONLY 17 WEEKS OF GEOSAT DATA)*

** *FEWER THAN 4534 VALUES RESULTED DUE TO THE USE OF SLIGHTLY DIFFERENT EDITING IN SCREENING THE COMPUTED 30′ BY 30′ MEAN GRAVITY ANOMALIES AWAY FROM THE LAND AREAS*

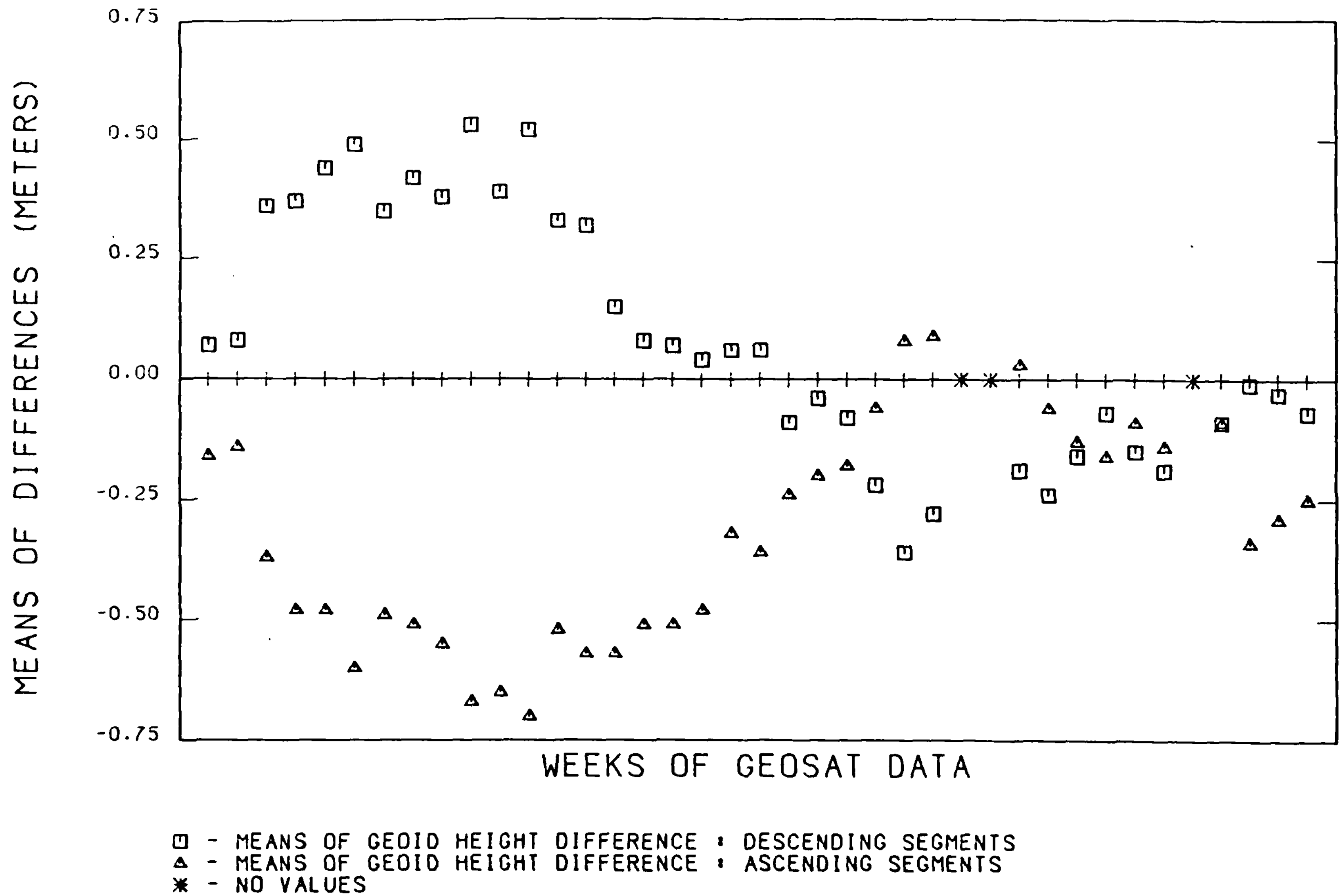

FIGURE 1. VARIATION IN THE MEANS OF DIFFERENCES BETWEEN GEOID HEIGHTS FROM ASCENDING AND DESCENDING SEGMENTS OF GEOSAT'S REVOLUTIONS (BOTH SETS COMPARED TO WGS 84 (n=m=180) GEOID HEIGHTS) COMPUTED FOR CONSECUTIVE SEVEN-DAY DATA SETS.

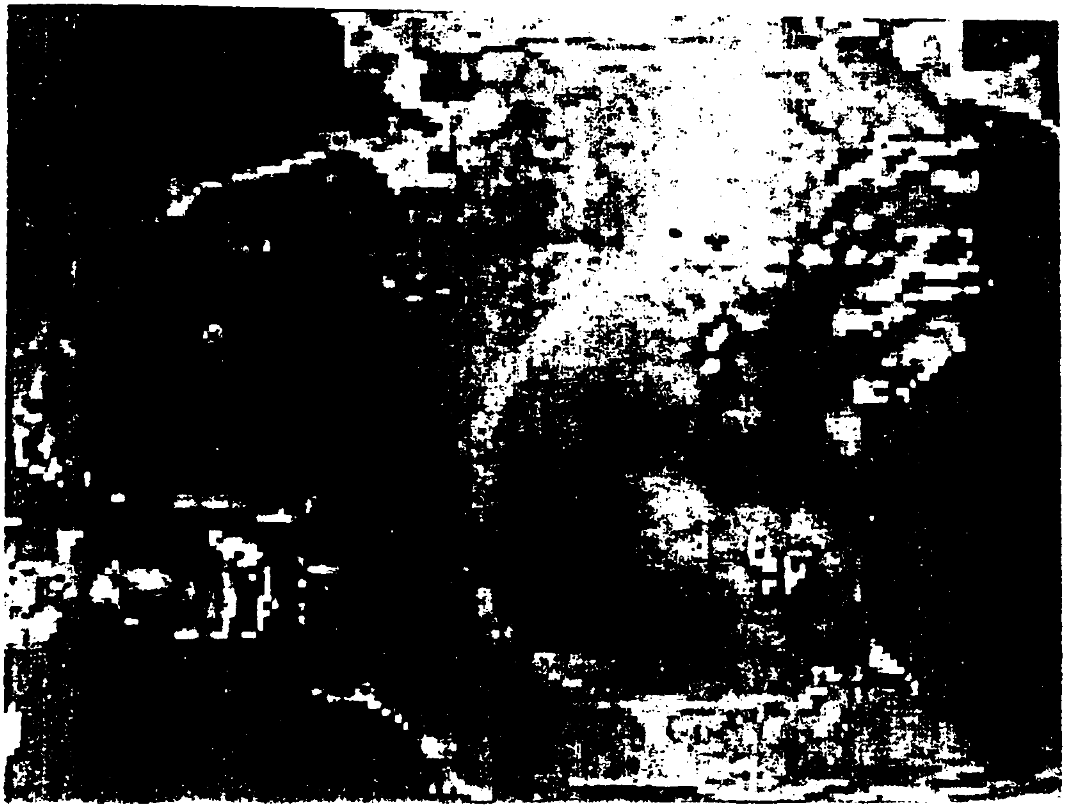

FIGURE 2. IMAGE OF GEOSAT 30' BY 30' MEAN GRAVITY ANOMALY FIELD
(NORTH ATLANTIC AREA)

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